

C. Remarks

The claims are 6-26, with claims 6 and 15 being independent. Claims 1-5 have been cancelled. Claims 11-13 and 15-26 have been withdrawn from consideration. Reconsideration of the claims is expressly requested.

Claims 1, 2, 5-8 and 14 stand rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over JP 6-208076 (Sakamoto). The Examiner has alleged that JP 2-109003 (Ota) teaches that an intermediate layer can contain titanium oxide, which helps to increase the durability of the mirror.¹ Therefore, it is the Examiner's position that it would have been obvious to substitute titanium oxide for Sakamoto's chromium material, which the Examiner deemed to be equivalent alternatives. The grounds of rejection are respectfully traversed.

Prior to addressing the merits of rejection, Applicants again would like to briefly review some of the key features and advantages of the presently claimed invention. The present invention, in part, is directed to a metallic mirror comprising an aluminum or aluminum alloy substrate with an intermediate TiO_2 layer and a metallic reflective Cu layer formed on the intermediate layer. A protective layer including at least a layer of Al_2O_3 is formed on the metallic reflective layer. The presence of the TiO_2 intermediate layer overcomes the problem of film lifting, which is present in the prior art.

Chromium intermediate layers are typically used in metallic mirrors. However, when such mirrors have an aluminum or an aluminum or aluminum alloy

¹/The Examiner has advised Applicants' attorney during a telephonic interview that a response to the final Office Action filed on February 19, 2004 overcomes the rejection based on the combination of Sakamoto and Grewal. Accordingly, Applicants only address the rejection based on Sakamoto and Ota in this Amendment.

substrate, a copper reflective layer and an aluminum oxide protective layer, the intermediate layer tends to separate from the reflective layer.

This phenomenon of "film lifting" is clearly shown in the present application in photograph 4 in Fig. 9 and photographs 6-8 in Figs. 10-12. As can be seen from these cross-sectional photographs, films are separated at the interface between the intermediate layer Cr film and the reflective layer Cu film.

As discussed in the original specification at page 4, line 16 to page 5, line 2, stress measurements for each film among the intermediate chromium layer, the reflective copper layer and the Al_2O_3 layer show that the Cr film has a stress of $+4.15 \times 10^8$ Pa, the Cu film has a stress of $+1.53 \times 10^8$ Pa, and the Al_2O_3 film has a stress of -0.63×10^8 Pa. Such vast differences in stress among these films are indicative of the separation between the Cr film and the Cu film.

Applicants have determined that if the intermediate layer contains titanium oxide, the above-mentioned defect is avoided and the necessary reflective characteristics of the mirror are maintained.

Sakamoto discloses a metallic mirror that has a Cr intermediate layer. In fact, it has the typical structure, which is described above. While the Examiner has acknowledged that Sakamoto does not disclose or suggest a titanium oxide intermediate layer, the Examiner continues to allege that it would have been obvious to replace the chromium intermediate layer with TiO_2 based in the disclosure in Ota. Applicants respectfully disagree.

Ota is directed to the improvement of adhesion in a reflective mirror by varying the thickness of the intermediate layer. Ota discloses a number of substrates and

intermediate layers, which can possibly be used in a mirror. However, Applicants respectfully submit that Ota fails to disclose or suggest combining an aluminum or an aluminum alloy substrate with a titanium oxide intermediate layer, a copper reflective layer and an aluminum oxide protective layer.

Neither Sakamoto nor Ota recognize a problem associated with the separation of specific layers disclosed in Sakamoto, which separation is clearly demonstrated in Figs. 9-12 in the present application. Clearly, since these references cannot recognize the problem, they cannot teach or suggest a solution.

Ota merely provides a laundry list of possible intermediate layers, substrates and reflective layers, focusing solely on non-metallic mirrors and intermediate layers, which are not titanium oxide.² In fact, considering the disclosure in Ota as a whole, Applicants respectfully submit that the advantages mentioned by Ota with respect using its intermediate layers are associated with a non-metallic substrate. No specific metallic substrates are disclosed, much less their relationship with specific layers formed thereon, and it is clear that mirrors based on non-metallic substrates have different problems and concerns than metallic mirrors of Sakamoto and the present invention.

Applicants respectfully submit that selecting titanium oxide, which is mentioned by Ota (just like a metallic substrate) only in passing among a long list of

²Specifically, Ota states that a base can consist of an inorganic material such as glass, ceramic or metal, or an organic high polymer material such as polystyrene, polymethylmethacrylate, polycarbonate or a copolymer of acrylonitrile and styrene. The intermediate layers specifically disclosed by Ota include chromium oxide, titanium oxide, tungsten oxide, tin oxide, indium oxide, aluminum oxide, chromium nitride, titanium nitride and tungsten nitride. Also, Ota discloses a number of possible reflective layers, which can be formed on the above-mentioned intermediate layers, including a nitride of aluminum, gold, silver, copper or titanium.

possibilities, to replace the chromium layer in Sakamoto is impermissible hindsight based on the present application. There is no disclosure or suggestion in Ota that a titanium oxide layer can be used in combination with an aluminum or aluminum alloy substrate and a copper reflective layer to produce a successful mirror, much less a mirror that solves the film lifting problem when the mirror also contains an aluminum oxide protective layer. Ota does not even disclose or suggest an aluminum oxide protective layer.

At most, based on the disclosures in Sakamoto and Ota, a titanium oxide intermediate layer is obvious to try, which is clearly insufficient for establishing a prima facie case of obviousness. Applicants respectfully submit that there is no suggestion or motivation to modify Sakamoto as alleged by the Examiner. A skilled artisan would not look to Ota for disclosure regarding the intermediate layer, because, as mentioned above, the disclosure in Ota is focused on non-metallic mirrors. Also, as mentioned above, there is no reasonable expectation of success.

Furthermore, the unexpectedly superior results of using a titanium oxide intermediate layer demonstrated by the Comparative Test and the results presented in, for example, Table 11 refute the Examiner's allegation of obviousness. Specifically, Applicants compared a mirror comprising an aluminum substrate, a chromium intermediate layer, a copper reflective layer and an aluminum oxide protective layer with a mirror in which the chromium intermediate layer was replaced with the titanium oxide layer. The results showed that the mirror with a chromium intermediate layer had a 23.7% rate of film lifting while the mirror with the titanium oxide intermediate layer had a 0% film lifting rate. This difference in film lifting rates is both substantial and significant, clearly showing the superiority of the presently claimed invention, which is unexpected.

In conclusion, it is respectfully submitted that the cited references, whether considered alone or in combination, do not disclose or suggest the combination of elements presently claimed. Wherefore, Applicants respectfully request that the outstanding rejection be withdrawn and that the present case be passed to issue.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address given below.

Respectfully submitted,



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